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Comparing Welfare Estimates from Fixed Status Quo Attributes vs People's Perceived Attributes of Water Quality.

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Comparing Welfare Estimates from Fixed Status Quo Attributes vs People's Perceived Attributes of Water Quality.

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Abstract

Data from a choice experiment on the community's preferences for water quality improvements in streams was used to assess the effect of using a fixed status quo versus people's perceived status quo on willingness to pay values. More than 50% of respondents perceived the quality of water in streams to be different to the status quo in the initial experimental design. Study results have shown that respondents who opted for their own perceived status quo alternative had stronger preferences and higher willingness to pay for water quality improvements than their counterparts.

Keywords: Choice experiments, Fixed status quo, People's perceived status quo, Willingness to pay.

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1.0 Introduction

As in most other countries, non-point source water pollution emanating from agricultural activities is a major environmental problem facing New Zealand. To address this situation, water pollution control policies have taken centre stage both locally and internationally. The need to evaluate such policies has attracted extensive empirical work including the valuation of the non-market benefits of water quality improvements. The international literature on the subject is replete with a large number of revealed and stated preference studies, addressing a wide array of the benefits of water quality improvements. For instance, Atkins & Burdon (2006) used the contingent valuation method to assess the public's preferences for water quality improvements due to reduced eutrophication in the Randers Fjord, in Denmark. In another study Johnstone & Markandya (2006) used the random utility travel cost method to estimate the benefits of marginal improvements in water quality on angler's welfare in the United Kingdom. More recently, Kragt & Bennett (2009) used choice experiments to assess the community's preferences for the protection of rivers and estuaries in the George Catchment Area in Australia. Other documented international literature on the subject include studies by Desvougues *et al.* (1987); Egan *et al.* (2009); Hanley *et al.* (2006) and Kaoru (1995).

Similarly, progress is being made with water quality valuation in New Zealand, although only a limited number of studies on the subject have been conducted so far (Yao & Kaval, 2007). An early study was conducted by Harris (1983) in which the contingent valuation method was used to estimate the community's willingness to pay to avoid deterioration of water quality in the Waikato Basin. Williamson (1997) used the same technique to assess the value that Auckland residents placed on water quality improvements in the Orakei Basin. More recently, Kerr and Sharp (2003) used choice experiments to assess the value that Auckland residents placed on the conditions of streams in their areas and Marsh & Baskaran (2009b) estimated a wide range of willingness to pay values for water quality improvements from a choice experiment in the Karapiro Catchment Area.

While the assessment of non-market environmental values such as water quality improvements has taken a central focus, research effort is also being channeled towards development of improved valuation methodologies. In particular the use of stated

preference techniques has spurred various controversies largely due to the fact that the pattern of responses in some stated preference surveys deviates from the postulations of economic theory about how individuals make preferences (Sugden, 2005). It is for similar reasons that the contingent valuation method has been subject to skepticism from several quarters, despite being the most commonly utilized technique (Diamond & Hausman, 1994; Kahneman & Kanetsch, 1992).

Since their inception in 1982, choice experiments have gained popularity in the valuation of non-market goods. Unlike the contingent valuation method, the nature and design of choice experiments makes it possible for a wide range of benefit estimates to be obtained from a single study. In choice experiments, respondents are presented with different alternatives defined in terms of product attributes and are asked to state, rank or select their preferred choice. The basic notion is that the utility that individuals derive from a good is a function of its various attributes. Therefore respondents are assumed to trade-off between all attributes within the choice set and choose the alternative that gives them the highest level of satisfaction (Benett & Blamey, 2001).

In spite of its popularity, the responses obtained from choice experiment surveys do not always conform to some of the assumptions upon which the technique is founded. Fischhoff *et al.* (1999) attribute most of the anomalies to the fact that either people filter in additional information to the one presented to make their choice task more real or neglect certain features presented to them to simplify their choice task. The latter propositions directly relate to attribute non-attendance in choice experiments. One of indispensable assumptions of choice experiments is that respondents consider and trade-off between all attributes in a given choice task before choosing their preferred alternative. This assumption has been empirically tested and most studies indicate that respondents do not attend to all attributes when making their choices. Studies by Campbell *et al.* (2008) and Scarpa *et al.* (2009) using data from a choice experiment on the public's attitudes towards landscape improvements in the republic of Ireland demonstrate evidence of non-attendance to one or more attributes. Similar findings were reported in a study by Meyerhoff & Liebe (2009) on the measurement of the externalities of onshore wind power generation in Westsachsen, Germany. All these studies indicate that accounting for non-attendance improves the performance of the estimated models.

We further explore the first proposition by Fischhoff *et al.* (1999) which stipulate that when faced with unrealistic information respondents may filter in additional features to make the choice task more real. This is investigated in the line of implied assumption in choice experimental design theory in which respondents are considered to take the status quo and the proposed changes in the quality of a non-market good as given. The possibility of violating this assumption as well as the possible implications on benefit estimates has not been fully investigated in non-market valuation studies. Drawing upon studies from other fields including psychology we draw an understanding of how people make decisions when presented with unrealistic or unbelievable premises. In most of these studies it was found that people made logical conclusions when presented with believable premises as opposed to unbelievable premises (Markovits & Vachon, 1989; Thompson, 1996). Thomson further asserts that when faced with unbelievable premise, people may substitute the unbelievable premise with a more believable one and make deductions based upon the believable premises. Alternatively, people may adopt a filtering mechanism whereby respondents may cast out any disbelief in the unbelievable premise and take the premises presented to them as realistic. The work by Manski (1999) provides a further understanding on how people make decisions when presented with incomplete information. Using a series of experiments Manski found that when presented with incomplete information people filter in their own future expectations in order to come up with logical conclusions. In all these studies investigated it was found that in the face of unbelievable or incomplete scenarios the actual output obtained tend to deviate from the expected output.

As already stated, choice experimental design theory explicitly assumes that respondents believe in the status quo and proposed changes presented to them. The study by Kataria *et al.* (2009) on scenario realism and its impact on welfare estimates forms part of the pioneering work in exploring whether respondents believe in all the information presented to them in choice task. Using data from a choice experiment on water quality improvements in Odense River in Denmark, the authors distinguished between respondents who believed in the status quo and those who did not and respondents who found the scenarios presented to them believable and those that did not. Their study results indicated that not accounting for respondent's beliefs in the proposed scenarios could lead to biased welfare estimates. We advance this investigation further using a different approach. Instead of simply asking respondents

whether they believed in the status quo or not, respondents were asked to state their perceived water quality attribute levels for the current situation. Respondents who had little or no idea about this were told about ‘our assessment of the current condition of streams in the catchment’ (*status quo – provided*). Respondents who were able to assess current water quality used their own status quo (*status quo – perceived*) in the choice experiments. We use data from a (2008) choice experiment on the conditions of streams in the Karapiro catchment to assess if there are significant differences in the willingness to pay values obtained from respondents who took the status quo as given and those who stated their own perceived status quo.

The remainder of the paper is organized as follows: section 2 describes the case study area i.e. the Karapiro catchment. An outline of the survey and experimental design are presented in section 3, followed by results and discussions in section 4. Finally, discussions and conclusions are presented in section 5.

2.0 The Karapiro Catchment

The Upper Waikato including all land that drains into the Waikato River from the outflow of Lake Taupo to the Karapiro dam has been identified as one of the water bodies in the Waikato region with a high priority for nutrient management (Broadnax, 2006). The study area for this research (the ‘Karapiro catchment’) stretches over 155,303 hectares and is defined as the lower part of this catchment from Lake Arapuni to the Karapiro dam including contributing tributaries (Figure 1). Land use is predominantly dairy (34%), pastoral³ (13%) and forestry (48%). Much of the areas now used for commercial pine forestry could potentially be converted to dairying. The Waikato Regional Council is seriously concerned that recent⁴ and planned land use changes in the catchment between Karapiro Dam and Taupo gates will lead to increasing levels of nitrogen and phosphorous in the Waikato River and its tributaries.

The amount of nitrogen and phosphorous reaching waterways in the catchment has generally been increasing and is expected to continue to rise because of intensification and conversion of land from forestry to dairy. Even with good farm management practices it is expected that the streams and rivers in the catchment will support more

³ Includes grazing, drystock, sheep, beef and deer.

⁴ Approx. 10-15,000 ha have already been converted from forest to dairy.

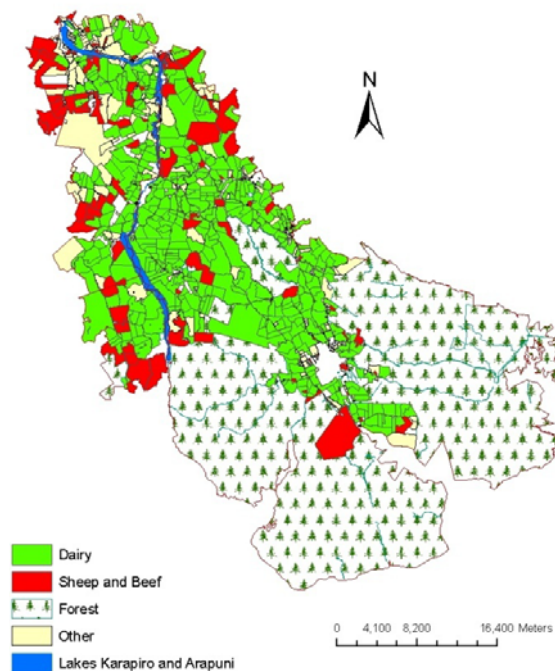
algae, clarity will fall and ecological health may decline. Levels of Ecoli may also increase.

3.0 Outline of the Survey and Experimental Design

Focus Groups

Four focus groups were held to build up an understanding of people's views on water quality in the catchment and to identify attributes for inclusion in the choice experiment. These sessions were also used to test early versions of the questionnaire and to discuss the appropriate range of values for the payment variable. Procedures for running the focus groups were developed drawing on Krueger (1994) and New Zealand experience from Bell (2004) and Kerr and Swaffield (2007).

Figure 1: Land Use in the Karapiro Catchment



Focus groups were held at the University of Waikato and at three primary schools representing different areas of the catchment (Karapiro, Kuranui and Waotu). The University focus group was a trial run using students who either lived or had grown up in the catchment. The Karapiro, Kuranui and Waotu focus groups were arranged by contacting the principal of the local primary school and asking if they would arrange for a suitable group of adults to attend the session in exchange for a donation to school funds. Schools were asked to provide six to eight people to attend the sessions that

lasted for about two hours. Participants were not told about the focus group topic in advance to try to avoid any bias towards those with a particular interest in water quality issues. Participants were roughly even in gender, normally resident in the local area of the school, from a range of age groups and included no more than one couple.

Focus group discussions highlighted the increasing number of fences on farms restricting animal access to streams and creeks. This was recognized as an improvement and many participants thought that stream water quality was improving, especially when streams were protected by fenced areas of bush, creating a natural filter. People in different areas had different perceptions of the quality of their local streams. For example some streams experienced by participants at the Karapiro focus group had poor water quality while participants at the Waotu group reported high quality streams with trout that were used for domestic drinking water supply. Further details on focus group procedures can be found in Marsh and Baskaran (2009)

Survey Instrument Design and Attributes

Questionnaire development and improvement took place over an extended period. Testing started using focus group participants, this was followed by a pilot survey using two groups of six participants and a pretest of 21 questionnaires. Focus groups were used to identify which water attributes people value and this was used to design the attributes for the choice cards. Focus group data was supplemented by literature review and discussions with experts in the field. The attributes selected for the final study were

- Suitability for swimming (percentage of readings that are satisfactory for swimming)
- Ecology (percentage of excellent readings)
- Native, fish and eels (presence of)
- Trout (presence of)
- Water Clarity (Can you usually see the bottom?)

The suitability for swimming attribute aligns with Objective 3 of the proposed National Policy Statement for Freshwater Management: “to ensure the progressive enhancement of the overall quality of Freshwater Resources, including actions to ensure appropriate Freshwater Resources can reach or exceed a swimmable standard⁵.” This attribute is

⁵ <http://www.mfe.govt.nz/publications/rma/nps-freshwater-management/nps-freshwater-management.html>

also intended as a ‘catch all’ that enables respondents to state their preference for water that is safe for all forms of contact recreation (swimming, paddling, fishing, eeling etc).

The ecology attribute aligns with data collected by Environment Waikato (EW) on the ecological health of waterways in the catchment (see Beard, 2007 and the EW website). Based on 100 monitoring sites across the region, EW reports that the ecological health of undeveloped catchments ranges from 23% excellent (Coromandel) to 100% (Upper Waikato), but for developed catchments the percentage of excellent readings is between 0 and 25%. The Karapiro catchment falls under the lower Waikato catchment zone and includes four EW monitoring sites (see Table 1).

The main threats to the ecology of rivers and streams in the catchment have been well summarized by Environment Waikato:

Before European settlement, New Zealand's rivers and streams flowed from the mountains to the coast through native forest and grassland communities. These forests and high altitude grasslands kept our smaller rivers and streams cool and shady. The clearing of this vegetation has made stream temperatures more variable, and less suitable for many of our native aquatic animals and plants. In addition to habitat loss through land clearance, our aquatic plants and animals have also been affected by other aspects of development including: barriers to fish passage, reduced water quality, changes to flow regimes, habitat loss (due to drainage and changes in land use). Some introduced species become pests that compete with or eat our native fish⁶.

Table 1: Ecological health in developed catchments (2005-08)

<i>Percentage of readings:</i>	Upper Waikato	Lower Waikato	Taupo	Whole Region
Unsatisfactory	8.3	68.4	20	47
Satisfactory	66.7	29.5	66.7	43.3
Excellent	25	2.1	13.3	9.6

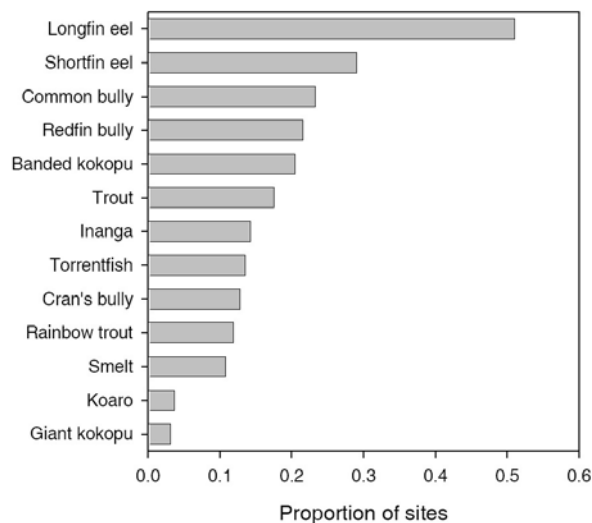
Source: EW⁷ Average Score per Metric (ASPM)

⁶ <http://www.ew.govt.nz/Environmental-information/Rivers-lakes-and-wetlands/healthyivers/Stream-and-river-life/>

⁷ <http://www.ew.govt.nz/Environmental-information/Environmental-indicators/Inland-water/River-and-streams/riv3-data/>

Native fish populations in the Waikato Region are documented in Joy (2005) - see Figure 2. These species are highly affected by the Waikato dams which prevent fish migration. The population of eels depends on recruitment (which has been falling steadily in recent years) and the number of elvers transported over the hydro dams. Shortfin eels (*Anguilla australis*) are very tolerant of poor water quality and may even increase with rising levels of N and P. In poor conditions these eels would mainly be 30 to 40 cms in length. If water quality increases (and sufficient numbers are moved over the hydro dams), then the population of longfin eels (*Anguilla dieffenbachia*) should increase. This species is far less tolerant of poor water quality and can grow to 2 metres in length. Native bullies and smelt should be migratory but landlocked populations exist in Lake Taupo. Numbers of these species may be expected to increase with better water quality. The ecological health and 'native fish and eels' attributes are assumed to vary together, for example poor water quality results in 'only small eels being found in most catchment streams' while high water quality leads to 'large eels, bullies and smelt being found'. See Table 2 below.

Figure 2: Native Eels and Fish of the Waikato Region



Source (Joy, 2005)

Respondents were asked for their assessment of the condition of streams in the catchment based on the attributes and levels used for the choice cards. Respondents who indicated that they had 'no idea' of the quality of the streams in the catchment

were presented with the status quo defined as ‘our assessment of the current overall condition of streams in the catchment’:-

- Fewer than 30% of streams are suitable for swimming
(<30% readings are satisfactory for swimming)
- Fewer than 40% of ecological health readings are excellent
- The only native fish/eels to be found in most of the catchment are small eels
- No trout are found in most catchment streams
- Usually you cannot see the bottom of streams in the catchment

Respondents who felt able to make their own assessment of stream quality used their perceived quality assessment as the status quo. In this case attribute levels were entered onto a transparent overlay and placed on top of each page of choice cards to make it easy for respondents to compare their perceived status quo with the alternative levels offered in each choice card.

Attributes and attribute levels are defined in Table 2. Choice cards were based on an orthogonal design of 72 choice sets, with each respondent completing 6 choice tasks.

Table 2: Attribute Levels

Attribute	Current Situation	Level 1	Level 2	Level 3
	Low			High
Suitability for Swimming	30% or less of readings are satisfactory for swimming	50% are satisfactory for swimming	70% are satisfactory for swimming	90% or more are satisfactory for swimming
	Low	Medium	High	
Ecology	Less than 40% of ecological health readings are excellent	40-70% are excellent	More than 70% of readings are excellent	
	Only small eels are found in most catchment streams	Small eels, bullies and smelt are found	Large eels, bullies and smelt are found	
Trout	No Trout (in most of the catchment)		Trout are found	
Water Clarity	Usually you cannot see the bottom	Usually you can see the bottom		
Cost to Household (\$ per year for the next 10 years)	\$0		\$50, \$100, \$200	

The Sample

The initial sample for this study was drawn by intersecting the Land Information New Zealand (LINZ) property title database with the catchment boundary layer in ArcGIS. In this way a list of all 7627 properties in the catchment was produced including physical location, territorial authority and other variables. The population was broken down into three strata to reflect the markedly different socioeconomic characteristics of these areas; namely Tokoroa, Putaruru/Tirau and the remaining rural areas.

Tokoroa is based around the forestry industry with the Kinleith timber mill being one of the largest employers. It has a population of around 15,000 with a relatively high population of Maori and Pacific Peoples with income levels being 15% below the New Zealand median. Putaruru and Tirau are smaller rural service centres located along state highway one, while the remaining areas of the catchment are predominantly rural with

the dairy industry being one of the largest employers. The catchment includes smaller settlements such as Karapiro and Arapuni (built to service construction of the hydro dams) and some areas of higher income 'lifestyle' properties especially along the shores of Lake Karapiro. While the catchment boundary passes through the middle of Tirau and Putaruru it was decided that the whole of these towns should be included in the survey population for the purposes of this study.

The sampling strategy aimed to complete sufficient questionnaires to be able to draw separate conclusions for each of the three strata. Address lists were drawn up for each strata and a random number generator used to draw up lists of addresses which were assigned to each enumerator. Field work proved to be very time consuming with each enumerator only able to complete three to six surveys each day. In order to try and reduce the amount of travel involved the sampling strategy was modified to allow enumerators to contact properties adjacent to those selected in the random draw, when the named property did not result in a completed interview. Field work was carried out both during the day and at weekends to try to avoid bias towards people staying at home. In the later stages of the survey a quota system was used to try and reduce bias towards people over 60.

Table 3 provides estimates for the population and number of households in each stratum based on data from the 2006 and 2001 census. These figures, especially for the rural stratum, are subject to a margin of error since the catchment boundaries do not coincide with Statistics New Zealand population area units.

Table 3: Estimated Population and Number of Completed Surveys

Stratum	Population	No. of Households	Sample	Sample %
Tokoroa	13,302	4,587	58	1.3%
Putaruru/Tirau	4,509	1,692	56	3.3%
Rural	4,112	1,523	64	4.2%
<i>Catchment</i>	<i>21,923</i>	<i>7,802</i>	<i>178</i>	<i>2.3%</i>
Notes: Tokoroa - based on 2006 population and household size of 2.9, Putaruru/ Tirau - based on 2001 census, Rural - assumes one household per address and 2.7 per household.				

4.0 Results and Discussions

4.1 The empirical Model

In this paper, we adopt the random parameter logit (RPL) model. Unlike the standard logit model, the RPL does not assume the IIA property and accounts for unobserved taste heterogeneity across individuals. The RPL is a behaviorally more appropriate and enables a more efficient estimation in cases where repeated choices are made by the same respondents (Revelt & Train, 1997). We start by specifying, the utility that individual i obtains from alternative k using the standard logit model. Assuming utility is linear-in-parameters the model is specified as follows:

$$U_{ik} = \beta' x_{ik} + \varepsilon_{ik} \quad (1)$$

Where U_{ik} is the utility that individual i obtains from alternative k , β is a vector of preference parameters for the population, x_{ik} is a vector of observed variables that relate to alternative k and individual i , ε_{ik} is the unobserved random term that is independently and identically distributed (IID) following a type 1 extreme value. The probability of individual i choosing alternative k in any choice occasion takes the form:

$$V_{ik} = \frac{e^{\beta' x_{ik}}}{\sum_k e^{\beta' x_{ik}}} \quad (2)$$

Unlike the conditional logit model, the RPL relaxes the IIA assumption thereby allowing the individual coefficient vector, b_i to vary across the sampled individuals. By relaxing the IIA assumption the RPL takes into account of observed and unobserved preference heterogeneity over the sampled individuals (Hensher *et al.*, 2005). Therefore the coefficients vector, b_i is assumed to vary across respondents and can be approximated by the sum of the average tastes in the population given by β and individual deviation, δ_i (Train, 1998). The RPL utility function specification is given by:

$$U_{ik} = b_i' x_{ik} + \varepsilon_{ik} = \beta' x_{ik} + \delta_i' x_{ik} + \varepsilon_{ik} \quad (3)$$

The researcher can only observe, β while δ remains unknown and hence $\delta_i' x_{ik} + \varepsilon_{ik}$ becomes the stochastic part of utility. The new random error term, $\delta_i' x_{ik} + \varepsilon_{ik}$ is correlated over alternatives through the common influence of δ_i . Therefore this

specification relaxes the IIA assumption while maintaining the IID assumption for the random error term, ε_{ik} (Hensher et al., 2005).

The RPL model assumes that individual tastes cannot be observed by the researcher, and inferences are made about the distribution of b_i . Individual tastes are assumed to vary across the population with density, $f(\beta/\theta^*)$ where θ^* represent the parameters of this distribution e.g. the mean and standard deviation. Therefore, the probability of individual i choosing alternative k is equal to the integral of equation (2) over all the possible values that β can take, weighted by the density β as given below:

$$P_{ik}(\theta^*) = \int V_{ik}(\beta) f(\beta|\theta^*) d\beta \quad (4)$$

4.2 The Socioeconomic and Attitudinal Characteristics of the Sample

Table 4 below gives the socioeconomic and attitudinal characteristics of the sampled individuals. However it should be noted that since the catchment boundaries do not coincide with boundaries used by Statistics New Zealand (SNZ), catchment level population data is unavailable. Nonetheless some conclusions may be drawn by comparison with data for Waikato Region as a whole.

Table 4: Socio-Demographic Data for the Sample and Region

	Provided	Perceived	Sample	Region
Gender (%)				
Males	60	62	62	49
Females	40	38	38	51
Age (%)				
Under 30	11	16	14	18
30-44	21	20	20	30
45-59	27	29	29	28
60+	40	34	37	25
Ethnicity (%)				
NZ/European	74	82	78	70
Maori	16	10	13	21
Asian	1	2	2	3
Pacific Island	3	2	2	5
Education (%)				
Any post secondary qual.	44	49	47	
Vocational/trades	19	21	16	
Diploma or certificate (>1 year)	19	37	24	
Bachelors degree	3	8	5	
Higher degree	1	4	2	
Income (%)				
<\$30,000	44	14	30	53
\$30 to \$50,000	18	21	19	21
\$50 to \$70,000	10	19	16	9
\$70 to \$100, 000	12	20	13	4
>\$100,000	10	15	11	3
Missing	7	11	11	11
Work on or own a farm (%)			25	
Location (%)				
Town	63	52	57	
Settlement	19	10	13	
Rural	4	16	11	
Farm	14	22	19	
<i>Sample Size</i>	<i>73</i>	<i>103</i>	<i>178</i>	

From the sample statistics in Table 4 above, there is an indication that males are over represented. This may be due the fact that more males than females were at home during the time of the survey or in cases were a couple were at home then the male was more likely to answer.

In terms of ethnicity, the majority of respondents are of NZ/European origin with the Maori and Pacific People being under represented. Furthermore, the statistics reveal that people with lower incomes are under represented. Given that the sampling methodology was random, the biases observed might be attributed to the characteristics of people who were at home when interviewers called, with most of them being old people or those who were not willing to participate in the survey. The highest refusal rate was experienced in Tokoroa with a response rate of 30% as opposed to other areas where the response rate was 60%.

There also some differences in the level of education and income between respondents in the *status - quo provided* category and those in the *status quo – perceived*. The statistics above show that 49% of the respondents in the *status quo – perceived* category hold at least diploma or certificate compared to 23% in the *status - quo provided* group. Likewise, 65% of respondents in the *status quo – perceived* category earn at least \$50,000 compared to 39% in the *status - quo provided* group.

Table 5: Description of variables used in Estimation

Variable	Description
ASC	Alternative specific constant
SWW90	90% chance that water is safe for swimming
SWW70	70% chance that water is safe for swimming
SSW50	50% chance that water is safe for swimming
SECOM	40-70% chance of good ecological readings
SECOH	> 70% chance of good ecological readings
TROUT	Dummy indicating whether trout is present or not
CLARITY	Dummy indicating whether people are able to see the bottom of stream or not
COST	Monetary attribute indicating the cost of achieving each specified scenario
TOWN	Dummy indicating whether a respondent resided in town or not
STREAM	Dummy indicating whether property/house is borders a stream
UNDERST	a measure of the level of understanding of the choice card questions taking values from 1 (not understood at all) to 10 (understood completely).
INCOME	Annual income per respondent

4.3 Model Estimation

The estimated RPL models are presented in Table 6 below. Model 1 shows the RPL results from respondents who had little or no idea of the condition of water quality in their areas and therefore opted for *status quo - provided*. Model 2 consists of the RPL results from respondents who had some knowledge of the condition streams in their areas in which case policy alternatives were based on *status quo – perceived*. Data was analyzed using NLOGIT 4.0 statistical software. The models were estimated using 100 Halton draws with parameters assumed to be independent and random and normally distributed except for the cost attribute which was assumed to follow a triangular distribution. The triangular distribution was used for the cost attribute to ensure non-negative willingness to pay values (Hensher et al., 2005). Attributes which repeatedly indicated an insignificant standard deviation over the range of draws were re-estimated as non-random variables with fixed parameter estimates. Since the study required individuals to make repeated choices for different scenarios, the models explicitly account for correlation in the unobserved utility over repeated choices by each individual (Brownstone & Train, 1999; Revelt & Train, 1997).

4.4 Model 1 and Model 2 Compared

The likelihood ratio test was used to test the null hypothesis of equality in parameter estimates obtained from the two models. The likelihood ratio test (LR) statistic is given by $-2 * [LL_r - (LL_{un1} + LL_{un2})]$ where, LL_r is the restricted log likelihood of the pooled model, LL_{un1} is the unrestricted log likelihood from model 1 and LL_{un2} is the unrestricted log likelihood from model 2. The LR test statistic for the comparison⁸ was $= -2[-819.178032 - (-349.243223 + -440.699792)] = 58.47$. The critical chi-square value at 5 per cent significance level, with 12 degrees of freedom is 21.03. Therefore, we reject the hypothesis that the parameter estimates obtained from the two models are equal. Hence separate models for the two treatments as opposed to the pooled model are the most appropriate. The results for the two models are presented in the Table 6:

⁸ The LR test was based on the RPL models with no social economic and attitudinal variables.

Table 6: Estimated Results⁹

Status quo - provided			Status quo - perceived		
Variable		MODEL 1	Variable		MODEL 2
Random parameters			Random parameters		
ASC	-2.2595	(1.7887)	ASC	-1.3880	(1.7241)
SSW90	1.9995***	(.3911)	TROUT	.1501***	(.2452)
SECOH	.5620	(.3789)	COST	-.0125***	(.0022)
CLARITY	.5416**	(.2498)			
COST	-.0271***	(.0039)			
Non-random parameters			Non-random parameters		
SSW50	.5399*	(.2942)	SSW50	.5954**	(.2533)
SSW70	1.2629***	(.3160)	SSW70	1.0275***	(.2616)
SECOM	.3984	(.2534)	SSW90	1.5306***	(.2783)
TROUT	1.1656***	(.2478)	SECOM	.7068***	(.2236)
TOWN	-1.4187**	(.6685)	SECOH	1.6205***	(.2501)
STREAM	-1.7381**	(.8356)	CLARITY	.9182***	(.1906)
UNDERST	.5332***	(.2156)	TOWN	-.0523	(.6550)
INCOME	1.1287	(.7920)	STREAM	-.3840	(.6909)
			UNDERST	.0770	(.2015)
			INCOME	.4563	(.7334)
Derived Standard deviations of parameter distributions					
NsASC	1.9135***	(.4424)	NsASC	2.689***	(.3726)
NsSSW90	1.1876**	(.5502)	NsTROUT	1.1116***	(.3258)
NsSECOH	2.1432***	(.5090)	TsCOST	.0125***	(.0022)
NsCLARITY	.9254***	(.3446)			
TsCOST	.0271***	(.0039)			
Summary Statistics			Summary Statistics		
Log L		-353.8574	Log L		-441.2428
AIC =	1.6934		AIC	1.4765	
BIC =	1.8518		BIC	1.584	
R ² (McFadden)	.2646		R ² (McFadden)	.3501	
N (Observations)	438		N (Observations)	618	

Notes: ***, ** and * denote significance at 1%, 5% and 10% respectively. The Figures in parentheses are standard errors.

The results indicate that both models are statistically significant, with most variables turning up with a priori expected signs except for the STREAM variable which turned up with a negative sign. All the swim attributes i.e. SWW50, SSW70, SWW90 are positive and significant in both models indicating that people are willing to pay for improvements in these attributes. The ecology attributes, SECOM and SECOH are insignificant in model 1 but highly significant in model 2. CLARITY is statistically significant in both models, but highly significant in model 2 compared to model 1. On the other hand, TROUT is highly significant in both models. Overall the results show that respondents in model 2 are more willing to pay for an improvement in water quality improvements for swimming, good ecological readings, clarity and trout than

⁹ These results should be regarded as preliminary. We intend to investigate alternative model specifications and carry out further analysis.

their counterparts in model 1. This is not surprising since model 1 consists of respondents who indicated that they had little or no idea about the condition of water in streams in their areas. This might be an indication that they were less interested in the use and non-use aspects of water in streams.

The COST attribute is negative and highly significant in both models indicating that people preferred alternatives with lower levels of cost. The Alternative specific constant (ASC) measures the variations in choices that cannot be accounted for by the attributes and the socio-economic characteristics of the respondents (Mazur & Bennett, 2009). The ASCs are negative and statistically insignificant in both models indicating that systematic factors did not affect the choice of status quo alternative.

The socioeconomic variables (TOWN, STREAM, INCOME) and attitudinal variable (UNDERST) were interacted with the alternative specific constant (ASC). TOWN and STREAM are negative and significant in model 1 but insignificant in model 2. The negative coefficient of the TOWN variables in model 1 indicates that people in town are less willing to pay for water quality improvements than their rural counterparts. The negative and significant STREAM variable in model 1 indicates that respondents living closer to streams were less willing to pay for water quality improvements. This is contrary to theoretical a priori expectations, but however, it should be noted that model 1 consists of respondents who said they had no idea about the conditions of streams in their areas. This lack of knowledge about the prevailing conditions of streams in their areas might imply that most of these respondents were less interested in streams and therefore less willing to pay for water quality improvements.

UNDERST, a variable that measured the level of understanding of the choice cards is positive as expected but only significant in model 1. The positive sign indicates that respondents who understood the choice cards were more willing to pay for water quality improvements than those who did not. Income is positive as expected but insignificant in both models. Overall the estimated results show that respondents in model 2 value improvements in water quality much more than respondents in model 1. This is not surprising since respondents in model 2 expressed knowledge of conditions of streams implying that they possibly had some special interests in the streams and therefore had regular contacts with water than those in model 1.

The differences in the results above could also be attributed to differences in the level of education and income between respondents in the *status - quo provided* category and those in the *status quo – perceived*. For instance, 49% of the respondents in the *status quo – perceived* category hold at least diploma or certificate compared to 23% in the *status - quo provided* group. Likewise, 65% of respondents in the *status quo – perceived* category earn at least \$50,000 compared to 39% in the *status - quo provided* group.

The estimates of the marginal willingness to pay from the two models are presented in Table 7 below. These estimates are based on a simulation procedure using the *sm* package in R statistical software, since division of the attributes by the cost coefficient can lead to systematic under estimation.

Table 6: Distribution of the Annual WTP per household for the Attributes (NZ\$)

Variable	Model 1					Model 2			
	1st Quartile	Median	Mean	3rd Quartile		1st Quartile	Median	Mean	3rd Quartile
SSW50	-2.85	17.11	22.64	39.69		7.14	32.31	42.79	62.05
SSW70	24.50	36.43	48.69	54.44		42.26	57.80	77.76	84.17
SSW90	40.64	55.61	74.88	81.07		61.99	86.90	116.64	127.51
SECOM	3.18	12.92	17.15	24.54		20.27	37.99	50.70	62.16
SECOH	-15.99	16.78	22.34	53.32		70.53	91.66	123.55	129.74
TROUT	24.88	32.42	43.72	46.07		27.77	62.06	82.87	106.85
CLARITY	1.19	16.18	21.47	33.56		35.73	56.24	74.95	85.97

The inter-quartile regression of the willingness to pay values is adopted because it shows additional information regarding the distribution of the willingness to pay values across respondents as opposed to a single mean WTP measure. For instance, 25% (1st Quartile), 50% (median) and 75% (3rd Quartile) of the respondents in model 1 are willing to pay \$-2.85, \$17.11 and \$39.69 respectively for the SSW50 attribute. The comparison of the distributions of the WTP values between the two groups show that respondents in model 2 are more willing to pay for water quality improvements than those in model 1. For respondents in model 1, the most valued attribute is SSW90 with the highest mean WTP of \$74.88, followed by SSW70 which has a mean WTP of \$48.69. On the other hand, SECOH is the most valued attribute by respondents in model 2 as indicated by the highest mean WTP amounting to \$123.55, followed by

SSW90 with a mean WTP of \$116.64. In general there is an indication that the WTP values from model 2 are higher than the ones from model 1 across the entire distribution.

To whether test whether the observed differences in the WTP values are statistically significant, we use the asymptotically normal test as applied by (Campbell et al., 2008). The normal test statistic for the differences in the mean WTP values is approximated by:

$$\frac{\overline{WTP}_k^1 - \overline{WTP}_k^2}{\sqrt{Var(\overline{WTP}_k^1) - Var(\overline{WTP}_k^2)}}$$

Where WTP_k is the parameter of the K th attribute, \overline{WTP}_k^1 is the estimate of WTP_k from model 1 and \overline{WTP}_k^2 is the estimate of WTP_k from model 2. The test results are presented in Table 7 below:

Table 7: Tests for equality of willingness to pay estimates

<u>Variable</u>	<u>Model 1 vs Model 2</u>
SSW50	-1.2115
SSW70	-5.34247
SSW90	-1.94313
SECOM	-2.29085
SECOH	-5.59203
CLARITY	-8.33324
TROUT	-11.9473

The test results indicate that there are significant differences in the mean WTP values for almost all the attributes with an exception of SSW50 and SSW90. The results confirm that respondents in model 2 valued water quality improvements much more than those in model 1 and therefore, were willing to pay much more money to ensure that the quality of water is enhanced.

5.0 Discussion and Conclusion

The purpose of the study was to assess the community's preferences for stream water quality improvements. The study was also designed to evaluate the usefulness of alternative specifications of the status quo that align with respondent perceptions. The study revealed that about 58% of the respondents had their own perceived base line condition of water quality. On the other hand 41% opted for the status quo provided because they had little or no prior knowledge of the prevailing conditions of water

quality in streams. The study results show marked differences in the value that these two groups of respondents place on water quality improvements and this has implications for their willingness to pay values. The respondents who adopted *status quo provided* expressed strong preference for water that is suitable for swimming and where trout are found. The second group of respondents, who adopted their own perceived status quo, expressed very strong preference for improvements in all of the attributes presented to them. This is also reflected in their willingness to pay values, with respondents in this group generally, registering higher willingness to pay values than respondents in model 1 across the entire distribution. The test results have further revealed that except for SSW50 and SSW90, the mean willingness to pay values for the two groups are statistically different from each other.

The study demonstrates the use of an alternative specification of the status quo that takes direct account of respondent perceptions. More comprehensive results on how this affects the accuracy and robustness of willingness to pay estimates could be obtained by an experimental design that assigns *status quo - provided* and *status quo - perceived* to different sub samples while also collecting information on individual perceptions of current attribute levels.

The study results are also in line with the findings by Kataria et al (2009) which showed that failure to take into account of the respondents beliefs lead to biased welfare estimates. The welfare estimates obtained from choice experiments and other non-market valuation techniques are designed to aid policy formulation. Therefore results from this study have shown that an experimental design that takes into account the respondent's perceptions of the prevailing environmental quality may assist policy making and lead to better allocation of resources.

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